A method is described for studying epr spectra in crystals under the action of an external electric field which is applicable to a RE-1301 spectrometer, in the resonator of which a quartz cryostat extension is housed. A viscous electrically insulating grease is used, making it possible to carry out investigations in electric fields up to 700 kV cm^{-1} at T = 77 and 4.2 K.

A method for applying strong electric fields in electron paramagnetic resonance at low temperatures

R. Sh. Usmanov

In most work studying the effect of an external electric field on the epr spectra of impurity ions at room temperatures, the method for applying electric fields to the crystal follows Royce and Bloembergen.[1] A semi-transparent layer of Ag is deposited on specimens made in the form of thin plates and leads are soldered to it. The crystal is completely covered with insulation to prevent electrical breakdown at the electrode edges. For insulation, picein,[2] polystyrene foam,[3] or a mixture of picein and powdered quartz[4] are used. Nepsha[5] stuck the crystal into a bakelite mount with silicone varnish. At low temperatures, supercooled liquid N_2[6] and liquid He[7] act as the insulating medium; electric fields up to 150 kV cm^{-1} could be applied in such a medium.

The method proposed makes it possible to study epr spectra at temperatures $T = 4.2$ and 77 K in external electric fields with strengths up to 700 kV cm^{-1}. After orientating the crystal by x-rays or from the epr spectrum, the section, 1, is prepared in the required plane. The crystal is then polished to the necessary thickness (0.15 to 0.60 mm), degreased with ethyl alcohol and the plate, 2, so obtained has a thin layer of electrode deposited using indian ink TU6-15-458-70. A substrate, 3, is made from a 0.8 mm thick bakelite sheet and the current lead graphite layer is deposited on this. The high voltage is applied to this surface through a single connector of multistrand copper wire. Specimen 2 is fixed by one electrode with indian ink to the substrate and by the other electrode to the earth lead. The crystal is covered with insulating grease, 1, which solidifies at low temperature, to prevent electrical breakdown at the edge.

It is known[8] that the coefficient of thermal expansion can be controlled by the introduction of fillers into epoxy resins which increases their resistance to the effects of low temperatures. In preparing the insulating coating ED-5, a crystal was grown from GOST-10587-72 epoxy resin with a filler of salt, in the proportion 1 : 2 by weight.

At liquid N_2 temperature a coating using the salt $CaWO_4$ was found suitable for a fairly broad type of crystals: CaF_2, BaF_2, $CaWO_4$, $CaMoO_4$, $LiYF_4$, $MgWO_4$, NaCl, TGS, $KZnF_3$, $KMgF_3$, Al_2O_3 and $Y_3Al_5O_{12}$.

Cracking of the crystals was not observed. The action of the electric field was monitored by the change in the epr spectrum. For the coating the ratio of the components was not critical and its properties did not deteriorate significantly over a period of time.

The merits of the proposed method are thus the speed of preparing and changing the specimen to be studied and the possibility of applying it to crystals with different coefficients of linear expansion. Tests over three years show that the whole design is trouble-free and reliable. Results of investigations carried out by this method have been published elsewhere.[9-11]

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The author is grateful to V.S. Kropotov and V.A. Sakharov for their constant interest in the work and for their advice, and to Sh.U. Usmanov for help with the photography.

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